

# Global Source for IR Optics and Materials



## Germanium (Ge)

Germanium is the most widely used material for making lenses and windows in infrared (IR) optical systems operating in the 2–14  $\mu\text{m}$  range. Due to its wide transmission range in the infrared and opaqueness in the visible light regions, Germanium is well suited for manufacturing of optical components for IR applications in lasers and thermal imaging systems.

## Specification

Physical Properties	
Density, 298K, (g/cm <sup>3</sup> )	5.33
Hardness, (kg/cm <sup>2</sup> )	800
Young's Modulus, 298K, (Gpa)	
<100>	103.3
<110>	138
<111>	155.5
Thermal Conductivity, 300K, (Wm <sup>-1</sup> K <sup>-1</sup> )	59.9
Thermal Expansion Coefficient, 300K, (/k)	6.0 x 10 <sup>-6</sup>
Specific Heat Capacity, 298K, (J/kg · K)	322
Dielectric Constant	16
Melting Point, (°C)	937.4
Crystal Structure	Monocrystalline / Polycrystalline
Purity	> 99.999%
Conductivity Type	n
Resistivity	0.03–50 $\Omega \cdot \text{cm}$
Poisson's Ratio, 125 ~ 375K	0.278
Modulus of Rupture, (Mpa)	72.4
Surface Finish	Ra <sub>max</sub> 0.2 $\mu\text{m}$ to 4.0 $\mu\text{m}$ (D7 to D46)

Optical Properties	
Transmission Spectrum, ( $\mu\text{m}$ )	2 ~ 14
Temperature Coefficient of Refractive Index, (/K)	400 x 10 <sup>-6</sup>
Refractive Index, (10 $\mu\text{m}$ )	4.0052
Refractive Index Homogeneity	$\leq 1.0 + 10^{-4}$
Absorption Coefficient, 10.6 $\mu\text{m}$ , (/cm)	$\leq 0.035$
Optical Transmittance, 10.6 $\mu\text{m}$	$\geq 45.0\%$

### Formats/ Sizes/ Tolerances

Monocrystalline and Polycrystalline Ge Circular Disks and Wafers		Unit: mm
Diameter	3–310 (Single Crystal) 3–400 (Polycrystal)	
Diameter Tolerance	$\leq 0.05$	
Minimum Thickness	0.5	
Maximum Thickness	60	
Thickness Tolerance	$\leq 0.05$	

Monocrystalline and Polycrystalline Ge Rectangular Sheets		Unit: mm
Maximum Size	205 x 205	
Tolerance	0.1	
Minimum Thickness	Upon edge length	
Thickness Tolerance	Standard 0.1 (Thickness $\leq 100\text{mm}$ )	

Germanium Lenses		Unit: mm
Diameter	7 – 260	
Diameter Tolerance	Standard: 0.1	
The Radius of Curvature Tolerance	Standard: 0.2%	
Center Thickness Tolerance	Standard: 0.1	
Edge Thickness Variation (ETV)	$\leq 0.05$	

Wavelength, $\mu\text{m}$	Refractive Index
2	4.10972
3	4.04550
4	4.02552
5	4.01652
6	4.01171
7	4.00878
8	4.00691
9	4.00557
10	4.00462
11	4.00388
12	4.00327
13	4.00278
14	4.00245

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